THE MICROSCOPE IN THE GOVERNMENT WORK IN WASHINGTON.

Dr. J. MELVIN LAMB, Washington, D. C.

Washington is preëminently a scientific city. It has in active operation six large scientific societies, respectively, Anthropological, Biological, Chemical, Geographical, Microscopical, and Philosophical, together with several smaller clubs for scientific purposes, having in all a membership of nearly twelve hundred.

Many of the members of these societies are occupied with research work of a microscopical character for the Government, besides many others are constantly and actively employing the microscope either as instructors or for recreation.

In consideration of the National Society meeting here, the microscopic work of the Government is a timely theme, and to some of you the subject may be a novel one, and it is one to which I feel myself unable to do justice.

The field of scientific work under the auspices of the Government in which the microscope is employed is extremely large, and I shall only endeavor to present a brief résumé of what has been done in the several departments, principally during the past year, and more especially to speak of such matters as I believe will have particular interest for our visitors. If I succeed in giving some information as to what is being done by the Government in microscopical science here in Washington, the purpose of my remarks will have been achieved.

The first department I would invite you to consider is the—

United States Army Medical Museum and Library.

The Army Medical Museum and Library occupies the new building located at the corner of Seventh and B streets S. W., east of the United States National Museum, and is under the direction of Dr. J. S. Billings, Surgeon, United States Army.

"The Museum collection was instituted in 1862 by Dr. William A. Hammond, then Surgeon General of the Army, and at first was limited to medical subjects, but of late years its scope has been greatly broadened, and is now nearly the same as that of the Royal College of Surgeons.

"It includes human anatomy, physiology, pathology, somatological anthropology, instruments and apparatus, medals, microscopes, and microscopical specimens." *

The collection is handsomely arranged in a fire-proof building, and at the close of the fiscal year terminating June 30, 1891, the Museum contained about—

10,135 pathological specimens,
3,314 anatomical specimens,
14,000 microscopical specimens,
about 2,000 specimens of comparative anatomy,
and about 175 microscopes, ancient and modern.

In certain departments, though not equal to the wealthy and long-established museums of Europe, its collections are nevertheless the most important in America, and are annually increasing in extent and value.

The Library of the Surgeon General's Office is the largest and most valuable *medical library* in the world. At the close of the fiscal year terminating June 30, 1891, it contained about 100,000 volumes and 150,000 pamphlets, including every branch of medical science, the next largest medical library in this country being the College of Physicians and Surgeons of Philadelphia, which contains about 47,000 volumes.

The library is designed for a reference library, and scientific men desirous of consulting works are granted free access and offered every facility for research.

While making mention of this collection, I should direct your attention to the incomparable literary work being done in this department, of value alike to the microscopist and scientist, as well as to the medical profession, and a work, I believe, more familiar to the medical than to other branches of science. I speak of the Index Catalogue of the Library of the Surgeon General's Office. This work has at the present time reached the completion of its twelfth volume, averaging 1,100 pages each.

* Billings (J. S.), Medical Museums, Med. News, Phila., 1888, LIII, 309–316.

In volume IX, pages 261–277 inclusive, will be found the subjects of "Microscope and Microscopy." These subjects are subdivided into the general subjects of Microscope, Microscopy, Patents relating to, Journals and societies relating to, Manipulations and preparations in, Medical microscopy, Microtomes and Microtomy. These various subjects furnish references to about 600 to 700 volumes and more than 1,000 references to periodical literature, giving the name of the author, title of article, title of journal, place of publication, the year, volume, and pages.

Contained in this library are many rare works of the sixteenth and seventeenth centuries, most curious and interesting study for the student of the history of the microscope, the ones bearing earliest dates being those of della Porta (Giovanni Battista), Magiæ naturalis (Lib. XVII), Lugduni, 1561 and 1597.

The collection is enriched in works of the seventeenth century by the books of Borelli, 1655; Robert Hooke's Micrographia, London, 1667; Sturmius (J. C.), Collegium experimentale, sive curiosum . . . telescopiorum microscopiorum et cet. . . . Norimbergæ, 1676; Schott (G.), Magia universalis naturæ et artis, Herbipoli, 1657–'77; Zahn, 1685; Griendelius (J. F.), Micrographia nova, Norimbergæ, 1687; van Leeuwenhoek, 1688; Dechales, 1690; Bonanni, 1691; and Hartsoeker, 1694; while among the works from the period of 1700 on to the present century we observe the writings of Paschius (G.), De novis inventis . . . Lipsiæ, 1700; Joblot (L.), Descriptions et usages de plusieurs nouveaux microscopes, Paris, 1718; Bion, 1723; Goeckel (J. C.), De microscopiis simplicibus et theoretice et practice consideratis, Jenæ [1733]; B. Martin, Micrographia nova, 1742; numerous works of H. Baker between 1742 and 1785; G. Adams, Micrographia illustrata, London, 1746; Muschenbroek, 1762; Fuss, 1774; and Della Torre, Nuova osservazioni microscopiche, Napoli, 1776.

With the general subjects so conveniently subdivided and including, by cross-reference, the subjects of air, brownian movement, diatoms, infusoria, instruments (optical), micrometer, microtomes, photomicrographs, toxicology (use of microscope in), urine and water analysis, patents, bacteriology, diagnosis, pathology, embryology, histology, etc., one can readily appreciate the value of such a work to microscopical research.

This library contains every current periodical devoted to medicine and microscopy, and the collection increases continually. In

modern microscopical literature the library may be said to be complete.

The Microscopical Laboratory of the Army Medical Museum, in charge of Dr. William Gray, is one of the most important sections of the museum and includes normal and pathological histology, embryology, bacteriology, and photomicrographic work. It contains between 14,000 and 15,000 specimens illustrative of microscopical research.

At the time of removal of this office from the old location, Ford's theater, to its present site, about four years since, this laboratory was entirely reconstructed and equipped with the latest and best microscopical instruments, lenses, microtomes, and apparatus of every description, and the photographic department has likewise every facility for electric and sun-light photography. Some patterns of the latest European microtomes have just been received, among which you will observe the large Weigert microtome, especially adapted for cutting sections dry or under alcohol. (See figure 1.) It is capable of producing sections of 5–6 centimeters surface and 0.015 of a millimeter in thickness.

When visiting the museum the beautiful photographs of histological and pathological specimens mounted above the cases should be noted. These are bromide enlargements made by projecting the original negative, whose diameter was about 2½ inches, upon a screen holding the bromide paper. The enlargements are made to 20 inches, or about eight times the original size. Most excellent photographs of transverse sections of the human cornea and retina, magnified 1,000 diameters; transverse sections of the oculo-motor nerve and optic nerve, magnified 3,000 times; transverse sections of bone, 1,000 diameters, and a large number of interesting plates illustrative of pathology, ranging in magnification from 500 to 3,700 diameters, form a part of this excellent and artistic collection.

Of special interest to the embryologist will be the serial section work of human embryos. Work in this direction has been conducted by Dr. Gray through a progressive series, beginning with the earliest stages of development up to the sixth month, many of them being sections of the entire specimen, both longitudinal and transverse. It is proposed to make this work the basis of a complete work of serial photography. Of these specimens as many as 500 to 600 sections constitute a series. Some of these serial sections are handsomely exhibited in framed transparent series, making, aside

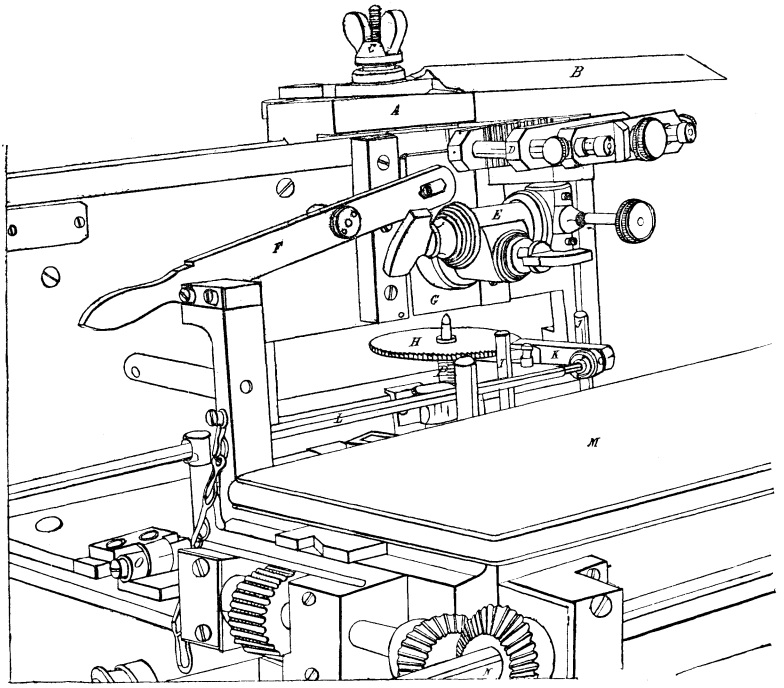


FIG. 1.—Weigert Microtome.

This apparatus is specially adapted for large sections ; also for cutting in liquids. The large size has a razor-course of 40 centimeters, and is capable of cutting sections 5 × 6 centimeters and of a thickness of 0.015 of a millimeter.

A—Knife-carrier in cradle.

B—Knife.

C—Knife-clamp.

D—Clamp for holding imbedded object.

E—Universal joints for adjustment of the object-carrier.

F—Quick adjustment for object-carrier.

G—Slide to which is attached the entire object-carrier.

H—Graduated disk upon the micrometer screw P.

I and J—Pins to regulate the stroke of K.

L—Rod by which K acts upon the graduated disk H and screw P, which raises the slide G. [L is operated by an extension of the rod to the end of the apparatus.]

M—Covered bath for holding fluid when used in wet cutting.

N—Crank with bevel gear for raising or lowering bath.

(A handle for operating knife-carrier is not exhibited in the cut.)

Dry cutting.—The plate shows the instrument properly arranged for dry work.

Cutting in fluid.—The entire piece of upright apparatus is thrown over on the hinge O, which immerses the object-carrier and knife in the bath, the cover M being removed.

from their scientific and technical worth, a most beautiful and artistic exhibit.

Bacteriological work is here conducted largely, and the department has a special laboratory for experimental pathology. Cultures of chromogenic and pathogenic bacteria are employed for illustration of the work of the division and for general use in the museum for exhibition.

A large feature of the work in this division is the diagnosis of specimens of morbid anatomy presented to the museum for proper classification in the pathological collection.

It is not my purpose to review the history of the microscope, so ably done by Mr. John Mayall, Jr., in his Cantor Lectures on the Microscope in 1885 (published in the Journal of the Society of Arts), but rather to direct your attention to a choice collection of ancient and modern microscopes contained in the Army Medical Museum, where you may observe the progressive stages by which the instrument has undergone a gradual progress of evolution during the past three hundred years, making this the tercentenary anniversary of its discovery, and illustrating its growth from the primitive model to the grand and perfect instrument of to-day.

It will be curious to note the naturally slow progress in the earlier period; the similarity of the models. As Mr. Wilson says in his recent paper in the International Journal of Microscopy, etc., "little original and difficult investigation being attempted, showing that the instrument was seldom sufficiently used to show its weak points." After the time that achromatism was applied to the microscope, about 1820, one can readily observe the progress made both optically and mechanically in perfecting the instrument. In the Army Medical Museum collection, which now numbers about 175 instruments of all forms, you may compare those made prior to the date of achromatism—the ancient—and those made subsequently to that period—the modern.

The first instrument of this collection I should invite your attention to is a copy of the first compound microscope known, according to the earliest authorities, who are agreed that it was invented by Hans or Zacharias Jansens or Janssen, a spectacle-maker of Middelburg, Netherlands, in the year 1591.

Mr. Mayall, Jr., in his Cantor lectures says: "It is upon this evidence generally, supplemented by that of Hans Janssen, the son of Zacharias, given in 1655, regarding his father's statement anent his early connection with the invention of telescopes and micro-

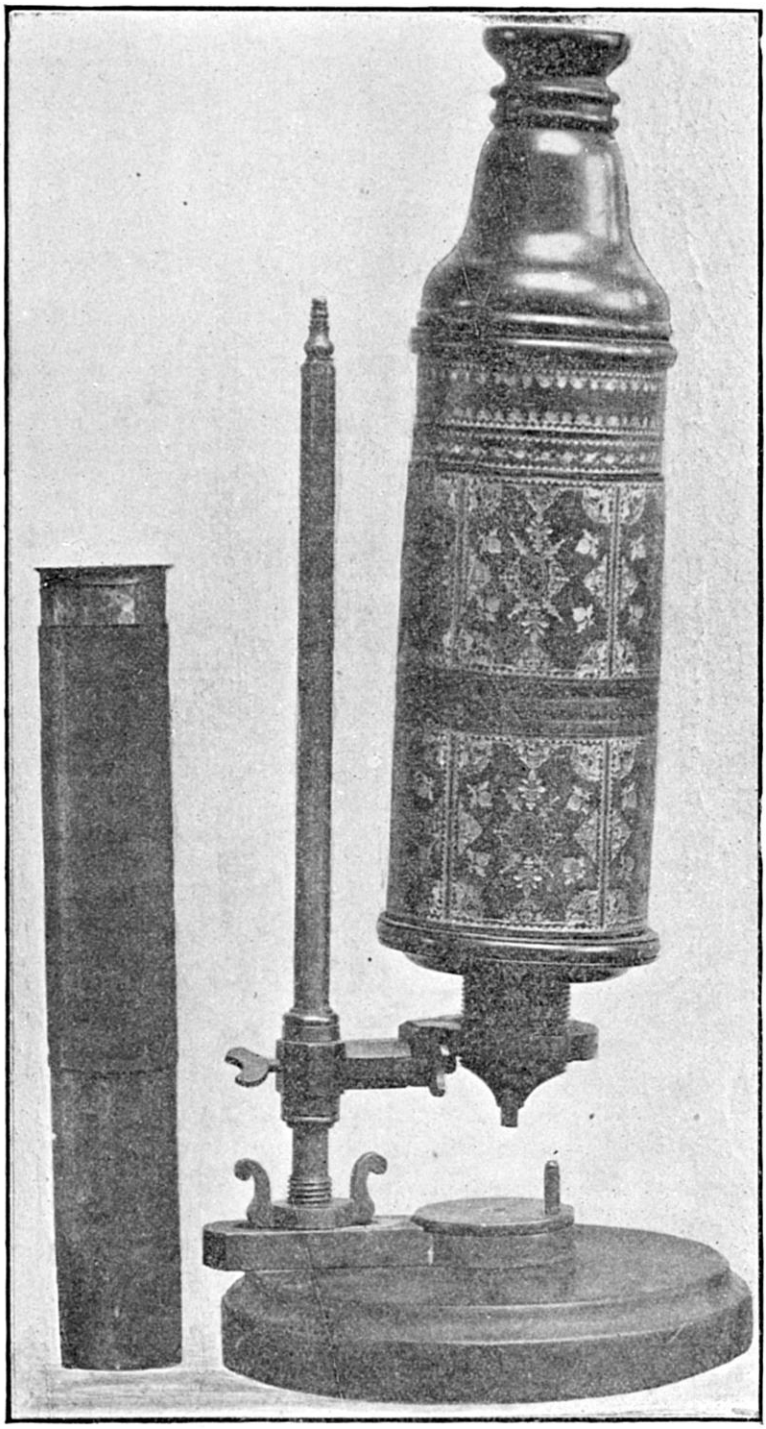


FIG. 1. FIG. 2.

scopes, that the possibility of the invention of the latter is pushed back even as far as 1590; and it would appear that the first microscope on record was designed principally to view objects by reflected light, not by transmitted light." I presume the drawings of this crude instrument are familiar to all, but a copy of the original model will have a keen interest for every one interested in the microscope. It consists only of two convex lenses connected by a tube roughly soldered together and sliding in a somewhat wider third tube. (See Pl. I, Fig. 1.)* The original instrument was presented by Mr. J. Snyder to the "Zeeuwsch Genootschap der Wetenschappen," and from that time its existence was so unknown, even in Holland, that it is not mentioned in such a complete history of the microscope as that of Harting.

There are no authentic documents concerning it. Harting came to the conclusion, after examining it, that it was really made by Janssen. (J. Roy. Micr. Soc., Lond., 1883, III, 709.) In 1876, when the original was exhibited at the Loan Exhibition, South Kensington, Mr. Crisp had a copy of it made, and in 1884 Mr. John Mayall, Jr., had a copy made after Mr. Crisp's model for the Army Medical Museum.

In 1891 Mr. Mayall went to Middelburg in person and examined the original instrument, was dissatisfied with the accuracy of the reproduction, and had four more reproductions made under his eye. One of these was to take the place of the reproduction in the Army Medical Museum and is the one shown in the plate (Fig. 1).

The points of difference between the first and second reproductions consisted in this: In the copy of Mr. Crisp the ends were soldered together, edge to edge, while in the original the edges overlap in all the tubes; secondly, in the original the tubes were *tinned* inside, while in the copy in Mr. Crisp's collection they were not.

Mr. John Mayall, Jr., of London, whose valuable and interesting papers on "The Microscope" you are all familiar with, and who has spent a great part of his life in the study of the history of the microscope, died but a few days since (July 27, 1891) of pleuro-pneumonia.

In this collection you may see a very pretty compound microscope by Giuseppe Campagni (Pl. II, Fig. 2), the body tube (with screw "draw-tube" carrying the eye-lens) of ivory, screwing into a

*The author is indebted to Dr. J. S. Billings, Surgeon, United States Army, for the plates illustrative of ancient microscopes.

ring socket of horn, mounted within a silver ring connected with three silver scroll legs, attached to an ebony base, triangular in shape, with concave ridges. When fully extended it stands about

PLATE II.

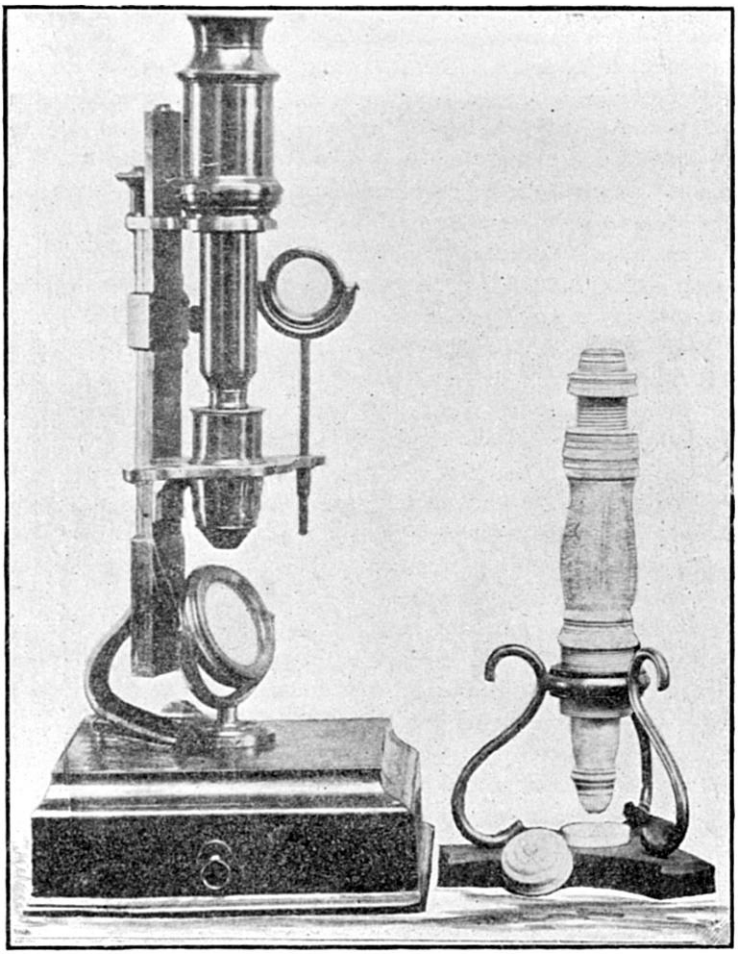


FIG. 1. FIG. 2.

a foot high. This is considered a beautiful example of an early microscope, and it antedates Hooke's (1665) by reason of there being no field-lens to the ocular. There are several microscopes

by Campagni in the collection bearing dates respectively of 1660, 1665, and 1670.

Next in chronological order of interest you will note a large compound microscope as figured in Hooke's "Micrographia," 1665 (Pl. I, Fig. 2). Hooke's microscope is generally admitted to be the *editio princeps* of the compound microscope, he being the inventor of that form. This is an especially interesting date in the early history of the microscope, and a close study of the instrument devised by Robert Hooke convinces one that he had practical knowledge and ability in the employment of the instrument. Many novel features are embodied in this instrument, and without doubt he was the first to give impetus to the optical as well as the mechanical construction. The Museum possesses two models of Hooke's microscope.

A compound microscope, all of wood, a modification of Homberg's model, and the one just mentioned of Campagni seem to be contemporaneous and represent a period from 1665 to 1680.

Four other models, two of them Italian microscopes of 1686 (see J. R. M. S., 1885, V, 518), a reproduction of Leeuwenhoek's, 1695, and a copy of Stephen Gray's "Water microscope," 1697, add to the collection for the seventeenth century.

The first half of the eighteenth century is represented very fully by the instruments of Leeuwenhoek, John Marshall, 1702; old Nurnburg microscope, Musschenbrock, 1702; Culpeper, 1720–1740; Cuff's models, one prior to 1840 and one about the middle of the century; George Adams, 1740 and 1742; and Cuff, 1740. For the second half of the eighteenth century the work of Ellis, 1755; Dollond, 1790; Martin, *ante* 1782; Jones, 1750, 1770; Wilson, 1746; D. Adams, Dellebarre, 1770, and Passemants, is exhibited by a number of instruments showing the progress of these various makers at different periods.

G. Adams's solar microscope (1750) for transparent and opaque objects is a very rare model and a beautiful specimen of an early solar microscope. (See G. Adams's Essays on the Microscope, Lond., 1787, p. 92, plate V, ed. of 1798.)

Culpeper's vertical tripod microscope, fish-skin covered body socket (about 1738) (Pl. III, Fig. 1); Cuff's model, 1740 (Pl. II, Fig. 1), and Dollond's microscope (Pl. III, Fig. 2), 1790–1800, are all beautiful specimens of the latter part of the eighteenth century.

Subsequent to the year 1800 the instruments of about forty makers are represented, among them appearing Harris, 1800; Brock, 1800; Utzschneider, 1820; Shuttleworth, 1815; Rienks, 1825; Amici,

PLATE III.

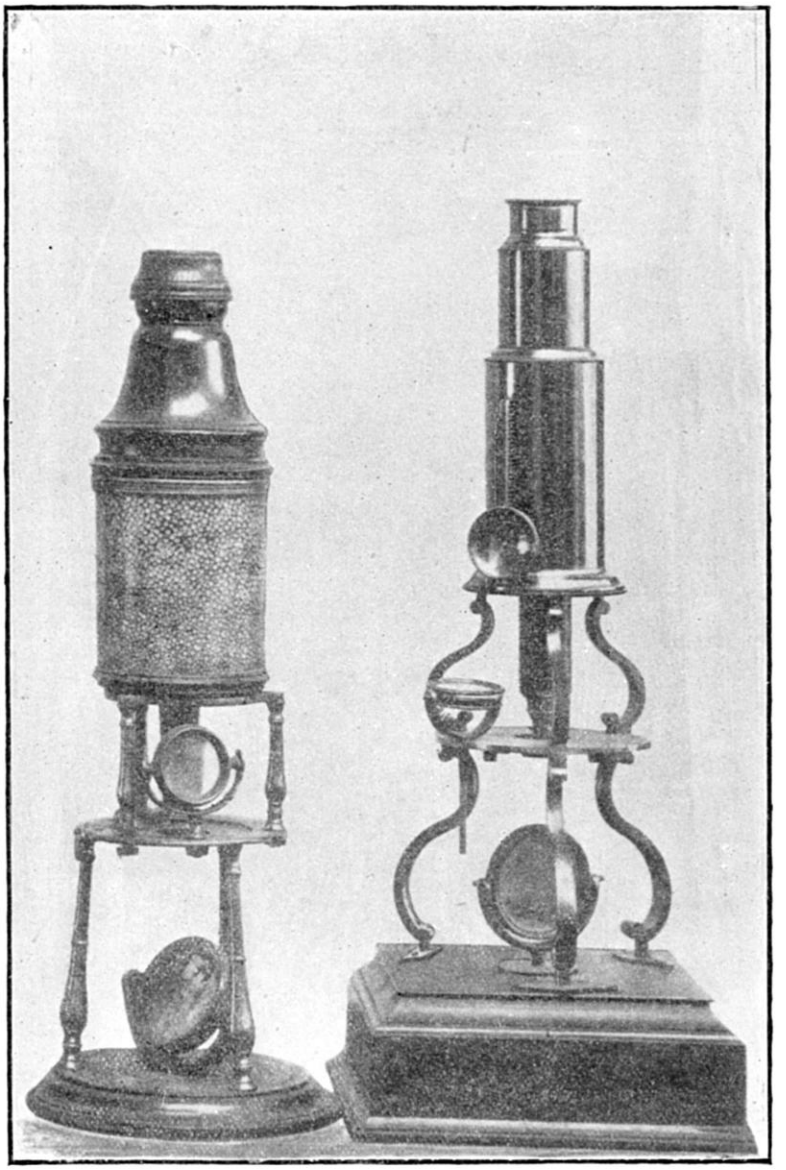


FIG. 1. FIG. 2.

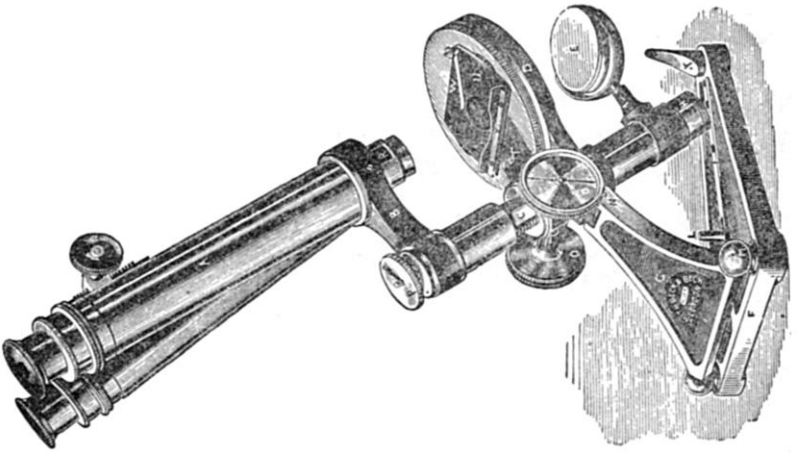


FIG. 3.

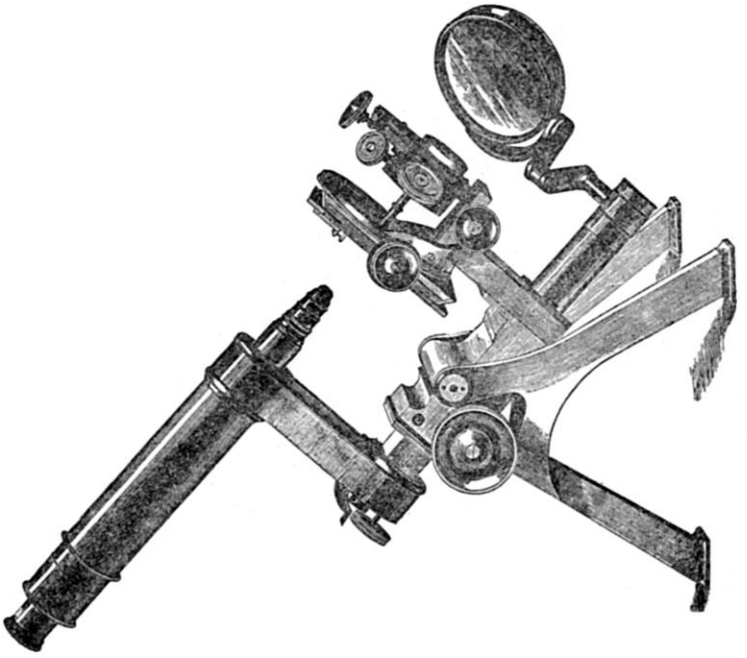


FIG. 2.

1830; Andrew Ross, 1832; Brahams, 1835; Carpenter and Westley (a very early model), 1835; Oherhäuser, 1840; Grunow, 1852; Riddell, 1852; C. A. & H. Spencer, prior to 1855; Nachet, 1860; R. & J. Beck, 1868, and earlier models of Bulloch, Zentmayer, and Bausch & Lomb.

This collection contains also one of a series of five of Tolles $\frac{1}{6}$ lens

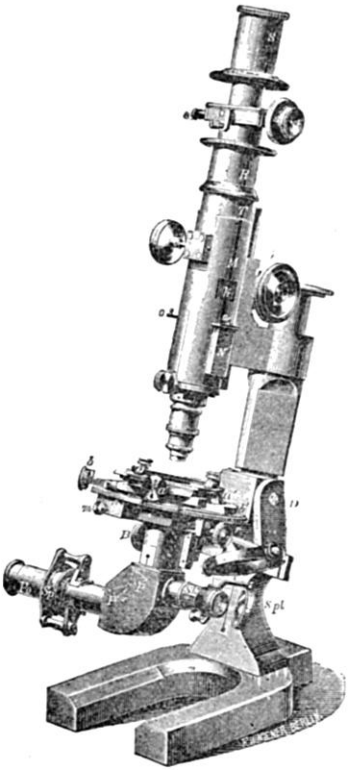


FIG. 4.

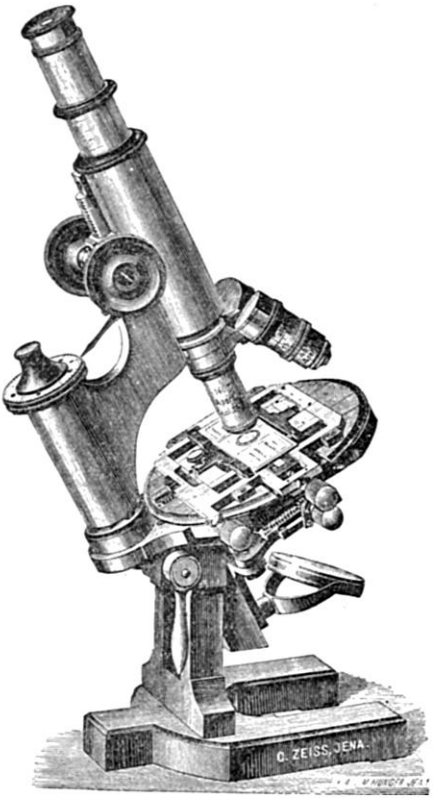


FIG. 5.

with interior prism, among the last made by Mr. Tolles and comparing favorably, by actual test, with those of Zeiss and Spencer.

To complete this general review of the history of microscope construction a few cuts are added of modern styles deserving of notice. Fig. 2 is a Powell and Lealand stand, preferred by the late Dr. Woodward, of the Army Medical Museum, and with which he did most of his world-renowned work in photomicrography. Fig. 3 is the Beck

Popular, of which it was said in 1880 that a larger number had been sold than of any other one pattern ever placed on the market. The importance of reliable substage fittings at the present time renders this, with others depending on a friction tube, unsatisfactory. Fig.

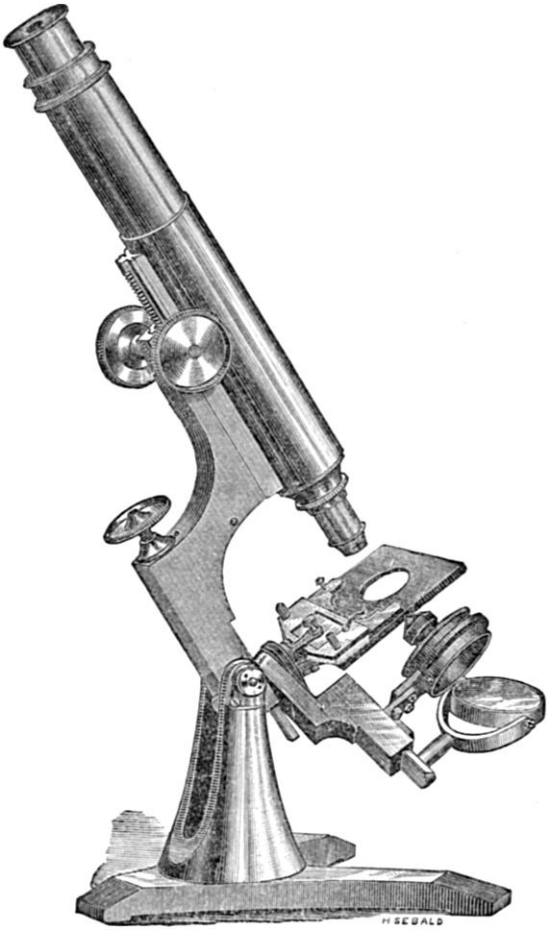


FIG. 6.

4 is the Fuess instrument, especially adapted for lithology, this and the Nachet form being preferred by workers of the rocks on account of peculiar arrangements for the rapid use of the polarizer and spectroscope. Fig. 5 is the present large Zeiss, which is especially

adapted for bacteriological and other high-power work now so much in demand. Fig. 6 is the Zentmayer Histological, designed in 1875, and which was one of the earliest, and it has always seemed to the writer one of the best, of "student stands." The swinging mirror on a tail-piece adapted to rise above the stage dispenses with the necessity for a condenser in viewing opaque objects. The principles of this stand were further elaborated in the Centennial stand (Fig. 7) and some of Zentmayer's improvements were extensively copied in Europe. But all these instruments with long tubes, though imposing in appearance, are less convenient in use than the modern short tube, with its corresponding objectives. The long tube cannot be shortened, but the short tube can be lengthened by a sliding draw tube to meet any demands for experimental work. Dr. Seaman informs me that he has for some years used a concentric stand of Bausch & Lomb and finds it very satisfactory. In its present shape the stand was designed by J. D. Cox, of Ohio, and it is unusually solid and free from vibration.* The preference of some particular form of microscope is partly a personal matter, sometimes depending on prepossessions acquired when learning its use. Those who desire to select should send for the catalogues of the various makers, where there is an abundant variety from which to choose.

Division of Microscopy, United States Department of Agriculture.

The Division of Microscopy of the United States Department of Agriculture was established in 1871, under the authority of Commissioner Capron, and has been in charge of Dr. Thomas Taylor since that date.

Dr. Taylor's first investigation for the department related to the parasitic fungi of the foreign grape-vines. His discoveries in this line demonstrated that the foreign grape-vines cultivated under glass structures in this country were attacked by a fungus well known in Europe as *Oidium tuckeri*, but the most important observation he made in this direction was the discovery of the higher fruit of this fungus.

During several years the microscopist gave special attention to the diseases of plants and to special remedies for plant diseases. He was the first to discover in this country a microscopic mite *Phytoptus*

* This stand was figured in the "Proceedings" 1883, p. 148.

See Fig. 10, p. 33, for "Concentric," and Fig. 11, p. 35, for the "Continental" of Bausch & Lomb, the latest style of American stand.

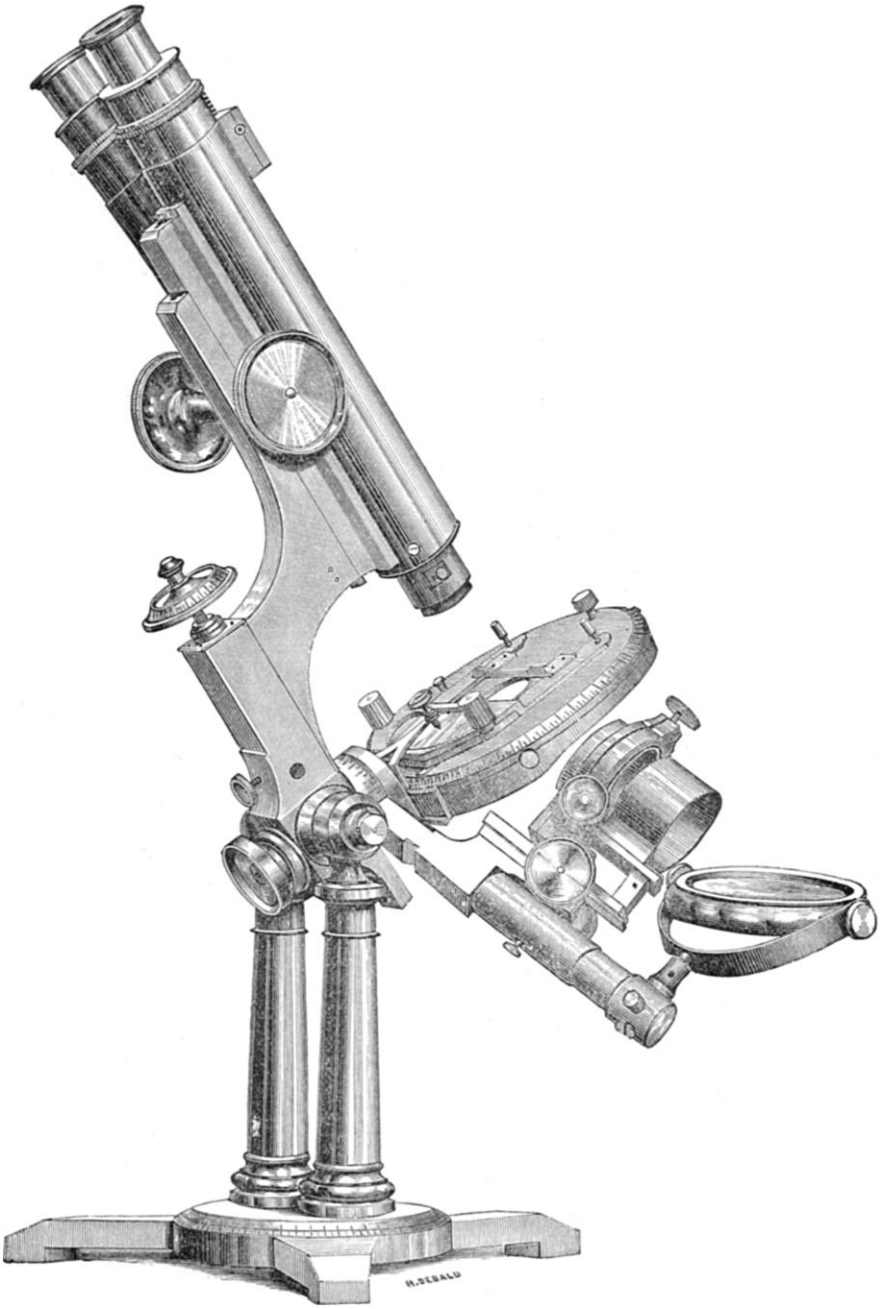


FIG. 7.

pyri, very destructive to the leaves of the pear tree, causing black blotches on them.

In some researches relating to the diseases of domestic fowls he discovered on the intercostal muscles living mites of the order *Acari* in various stages of growth. He also found the lung tissue infested with these parasites, which closely resemble *Cytoleichus sarcoptoides* (Megnin). In another case he found the cellular tissue of a fowl infested with mites, which proved to be *Laminosioptes gallinorum* (Megnin). The habitat of these mites seems confined wholly to the cellular tissue. Megnin says that many thousands of wild and domestic fowls are destroyed yearly by these mites.

Latterly the work of this division has been principally investigations of foods, food-fats, and oils, food adulterations (embracing the condiments), with special reference to lard and oleo compounds, by reason of the disclosures in lard adulteration, and reports on the edible and poisonous mushrooms of the United States. Of the latter, two bulletins have been published, which contain drawings beautifully colored after nature, with methods of cultivation and preparation for table use. A vast number of lard compounds have been examined and reported upon at the request of the Congressional Committee on Agriculture, as well as for special State committees.

This division has also given considerable attention to the animal and vegetable fibers, and its director has frequently been employed as an expert by the Government and, in several cases, in the district court of Pennsylvania, where fraudulent importations were suspected.

Dr. Taylor has made an extensive exhibit of water-color drawings of microscopic fungi, edible and poisonous, and also of vegetable and animal fibers. This collection will be placed on perpetual exhibition in the United States National Museum as soon as room can be obtained for it. He made a similar exhibit of microscopic work at New Orleans and at the recent International Exposition at Paris, France. At Paris he had on exhibition several instruments of precision of his own invention. This exhibit also comprised Dr. Taylor's work on the Crystals of Fats, of which the following account is taken from the notes of the meeting of the American Society of Microscopists held at Columbus, Ohio, by Dr. James, of St. Louis, Missouri.

"Among the remarkable exhibits made before the Society were the lantern slides of the crystals of butter, and fats, animal and vegetable, used in its adulteration and counterfeiting. These were

photomicrographs by Dr. Thomas Taylor, and were colored in the most exquisite manner to represent the appearance of the crystals under polarized light."

All the oleomargarine cases brought before the criminal court of the District of Columbia for violation of the law have been successfully prosecuted on such microscopic evidence.

Dr. Taylor is the author of a number of useful inventions, but only those are here mentioned which contribute to the cause of scientific investigation. Among these are the Taylor Freezing Microtome, the Pocket Polariscope,* and a machine for testing the tensile strength of textile fibers. In addition to these, during the past year he has contrived a machine for testing ropes and cords in connection with fiber investigation which is employed in the official work of the Department. His latest contribution to technical microscopy is a brass revolving turn-table, made to hold eleven glass slides of unique pattern, adapted to the study of serial sections and adjustable to most microscope stands. (See Figs. 8 and 9.)

Bureau of Animal Industry.

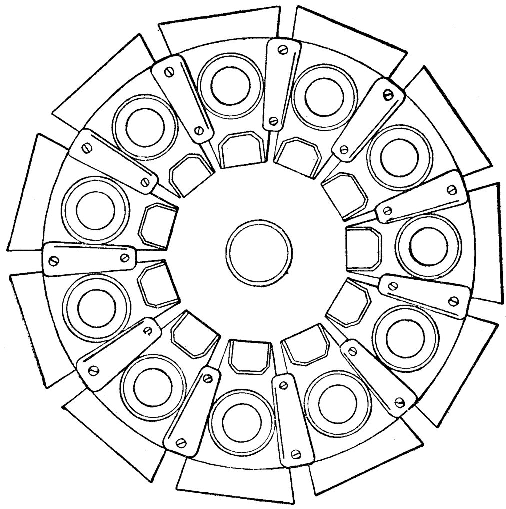
This bureau, a branch of the United States Department of Agriculture, is engaged upon bacteriological and pathological work, with the purpose of the prevention and eradication of contagious diseases among animals. The entire work of this important bureau is under the supervision of Dr. D. E. Salmon.

While it is my purpose to direct your attention to the work of microscopical character only, I would, however, make mention of the exceedingly large amount of work done by the agents of this bureau in the inspection of cattle for the limitation of pleuro-pneumonia. In the past year a total of 33,687 herds, containing 283,599 animals, were examined, while of this number 199,957 were re-examined. The labors of the Bureau of Animal Industry in the eradication of contagious pleuro-pneumonia, a question of great commercial interest, have been very thorough and successful.

The pathological and bacteriological work of this bureau is under the supervision of Dr. Theobald Smith, who is assisted by Dr. V. A. Moore.

The laboratory is now situated in a newly arranged building on B street, just south of the Department of Agriculture. It is furnished with every requirement of a modern laboratory, with a special

* Figured in "Proceedings" 1882, p. 153, and 1888, p. 159.



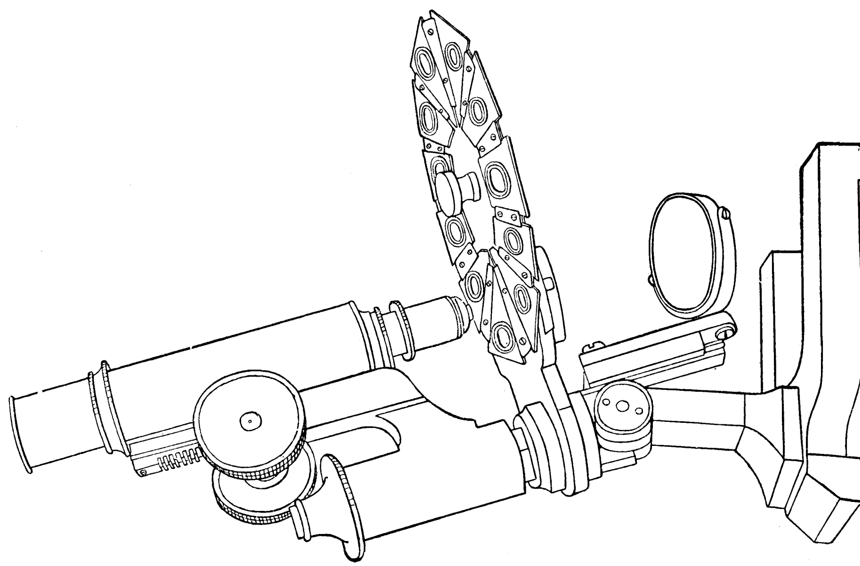


FIG. 8. Taylor's Revolving Stage for Serial Sections. FIG. 9.

chemical laboratory, and contains many of the best foreign makes of microscopes, microtomes, the latest and most improved lenses and forms of accessory apparatus. Its collection of slides descriptive of bacteriology and pathology is very large.

Dr. Theobald Smith has devoted much time to original scientific research, and his work of the past two years has been largely confined to Southern or Texas cattle fever and to the infectious diseases of swine.

In all of these investigations very important results have been obtained, both scientifically and practically.

He has discovered a germ in the red blood corpuscles, distinct from bacteria, but belonging to the protozoa.

He has demonstrated by a long series of experiments the transmissibility of Texas fever by the ticks, and that the micro-organism can be transmitted from one generation to the other without loss of virulence. He is still busily engaged upon this important subject.

Dr. Smith has investigated swine diseases to determine the relative prevalence of hog cholera and swine plague, the value of protective inoculation, and to test the practicability of preventing those diseases by the use of ptomaines or bacterial products. These investigations are continued and full reports will be found in the report of the bureau.

An experiment station in connection with this bureau is located near the city and is well equipped for experimental pathological work.

Recently this bureau has organized a commission for the detection of trichina in swine, which is doing a large amount of important work in Chicago. It has at the present time between 30 and 40 assistants engaged upon this investigation. It is intended to establish this work in all of the large cities of this country, with a view to limiting to the smallest possible per cent. the consumption of or export of infected food products. The introduction and spread of trichiniasis among swine has been materially lessened since these investigations began, and the per cent. of infected pork at the present day is very small.

The Division of Vegetable Pathology of the United States Department of Agriculture.

This division is under the direction of Mr. B. T. Galloway, and the microscope is principally devoted to the examination and identification of vegetable structures.

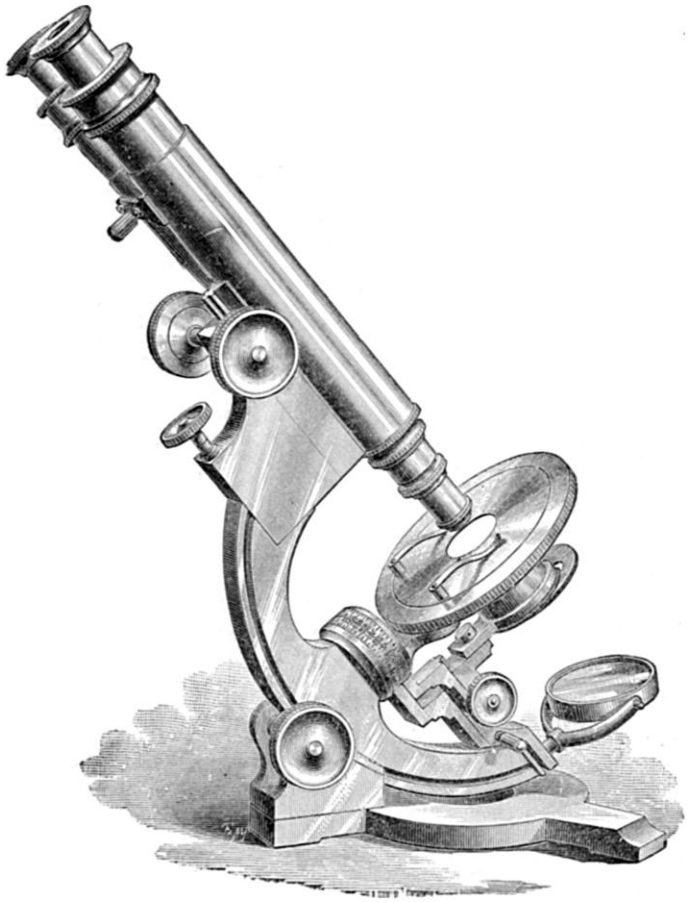


FIG. 10.—"Concentric Stand."

During the past two years the principal diseases under investigation were pear blight, bacterial diseases common to oats, diseases of the sweet potato, anthracnose of the cotton and hollyhock, peach yellows, the California vine disease, pear scab, cherry-leaf blight,

grape diseases, and diseases of green-house plants, particularly the carnation and violet.

A large variety of specimens are being received daily from every part of the country, are examined microscopically for purposes of identification, and report made with any information concerning the treatment recommended for the pathological condition. The late work of this division has been upon parasitic fungi, and considerable experimental research has been conducted by Mr. Galloway on the treatment of black rot, brown rot, downy mildew, powdery mildew, full and interesting reports of which may be found in the Journal of Mycology, published under the direction of the department.

Pear-leaf blight has also received considerable attention in the work of this division.

In conjunction with the laboratory work as above described a series of field tests with fungicides has been carried on by an assistant of Mr. Galloway, and much valuable data from this source are being continually added to the labors of the division.

Miss E. A. Southworth, assistant to Mr. Galloway, has given careful investigation to the anthracnose of cotton and hollyhock; also to the fungus peculiar to the ripe rot of grapes and apples, these subjects being of considerable economic importance, summaries of which will be found in the journal before mentioned.

The investigation into the nature of the California vine disease which has destroyed the vineyards of some of the finest vine-growing regions of that State is being steadily pursued. The progress made with a view to prevention and treatment is very marked, and the photographic records of untreated and treated specimens will prove of great interest to the visitor to this section of the Department.

Peach-yellow investigation, bacteriological and histological, has been conducted by Dr. E. F. Smith. Dr. Smith is in charge of the bacteriological section and is doing excellent work in the investigation of pear blight.

Here one can see the nature of this disease in its various stages, including means of inoculation, methods of culture, and examination. Diseases of oaks are receiving attention also in the bacteriological section.

The Division of Vegetable Pathology contains an exceedingly large and valuable herbarium, numbering many thousand specimens, and has an extensive collection of photography illustrative of the work of the division.

Division of Illustrations.

Within the past few months there has been organized in the Department of Agriculture a section known as the Division of Illustrations. Work of this character, descriptive of the investigations,

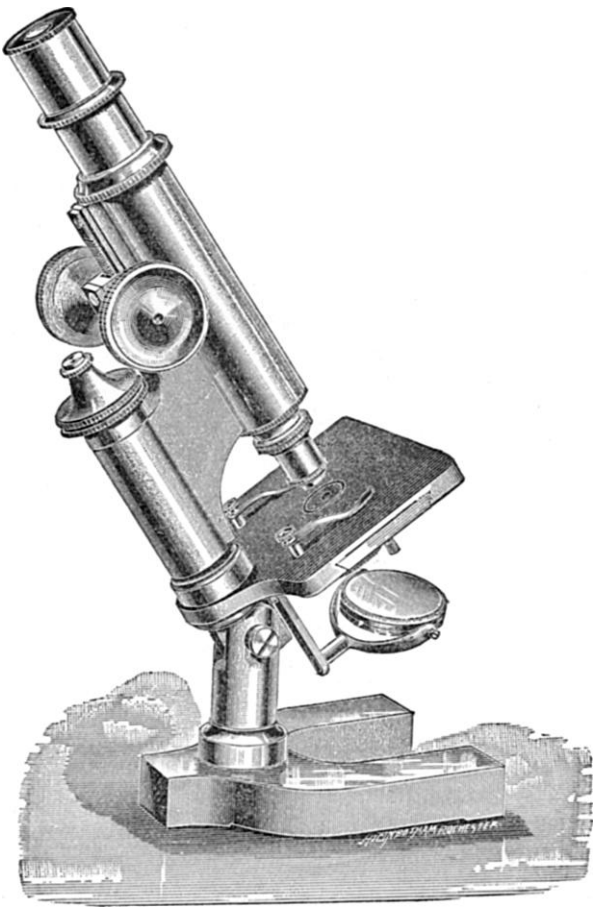


FIG. 11.—"Continental Stand."

etc., of the department, has long been continued, but at times by artists outside of the department. The work has increased to such an extent that it became necessary to arrange and systematize it. The Illustration Division is the result and has been placed under the

charge of Dr. George Marx, with eight assistants and additional engravers. To refer to his late report, "the work of the division is scientific, requiring great skill and experience, and, being from nature and often from specimens in a dried or injured condition, frequently calls for the greatest ingenuity on the part of the artist. Moreover, many of the specimens are so minute as to require the magnifying glasses or the microscope in elucidating the details, and our draftsmen, therefore, must be familiar with the management of these instruments. The work of the division consists in drawing illustrations on wood for engraving by the xylographers, or on paper with pen and ink, or painting them in water colors, the illustrations made by the two latter methods being reproduced outside of the department by lithography or by photo-engraving or by 'process work.'

"Many drawings, paintings, and sketches have been prepared in the division which are not intended for publication, but for the purpose of fixing graphically some interesting phase in the development or life history of objects from the plant or animal kingdom."

In the work of Dr. Marx and his assistants we observe a large number of beautiful plates descriptive of scientific observations of such excellence as to command the high praise of European scientific men and which have appeared in the annual reports of this department.

United States Geological Survey.

The visitor to the microscopical department of the United States Geological Survey will be afforded an opportunity to observe the extensive work of this department in the making of rock sections for microscopic study. The work in this section of the Survey is under the direction of Mr. Joseph S. Diller, who is engaged upon special geological observations from the sections.

Material in bulk is continually being received from every part of the United States, with requests for identification and report, and the Geological Survey has acquired a vast collection of named specimens, numbering about 250 of each kind and representing a total of nearly 70,000 specimens.

From the material in the rough state a small chip is taken, say, about ½ to 1 inch in diameter; by application to the rapidly revolving disk of the section-cutter, one side in a few seconds is made perfectly plane for attachment to glass slips to allow of handling while the reverse side is ground. This chip is then cemented to the glass plate by balsam and in a few moments ground down to the

desired degree of thinness ($\frac{1}{500}$ to $\frac{1}{250}$ of an inch) by the clever and delicate manipulation of the operator.

After the necessary smoothing, polishing, and washing, the section is removed by heat or turpentine from the glass slips to the slide, where in a few moments it is converted into an artistic and permanent preparation. You may have the pleasure of witnessing the preparation of such a rock section, a most interesting piece of technique, the entire process, from the rough chipping to the completed slide in readiness for the stage of the microscope, occupying less than thirty minutes.

As many as 400 sections are made every month and added to the rich collection of the Geological Survey, and last year the total number of preparations amounted to 5,000. The entire cabinet of permanent preparations illustrative of the microscopical structure of rocks contains over 25,000 slides.

Microscopic investigation is particularly well adapted to determine the crystallographic character of rocks, the presence of glassy constituents, the time order of crystallization, and whether or no the rock is a fragmental one; also the presence of minute organic remains may be detected, and by these characters altered metamorphic are distinguished from primary volcanic rocks, and with the aid of a few micro-chemical reactions the alkaline bases are more easily differentiated than by any other means.

United States Commission of Fish and Fisheries.

The microscopical investigations of the United States Fish Commission have been conducted principally with a view to a knowledge of the embryology of fishes. Very little work in pathological investigation has been attempted up to the present time, but it is intended to pursue some studies in this direction.

Some few years since considerable work of an embryological character was done under the supervision of Prof. John A. Ryder, now associated with the University of Pennsylvania. His more important researches are "The embryology of the sea bass (*Serranus atrarius*)," "Experiments bearing upon sturgeon culture," "An exposition of the principles of a rational system of oyster culture," "Preservation of embryonic materials and small organisms, together with hints upon embedding and mounting sections serially," and "The embryography of osseous fishes."

Very exhaustive investigations have been made on the parasites of crustacean fishes and on the entozoa of marine fishes of New

England, complete reports of which may be found in the papers of Mr. Edwin Linton.

The description of new species of parasitic copepods has been the work of Mr. Richard Rathbun, who is the author of a number of complete reports upon the same.

The morphology and embryology of the oyster has been the subject of exhaustive research by the Fish Commission, and a valuable history of the work is to be found in the papers of Professor Ryder on this subject and in a paper, which will appear at an early date as a publication of the commission, entitled "The oyster grounds of South Carolina and their natural condition; a report of the studies carried on during the winter of 1890 and 1891, by Mr. Bashford Dean."

At Wood's Holl, Mass., microscopical investigations are continually carried on concerning the food of fishes and of the oyster, the latter investigations being conducted chemically as well.

The greatr portion of the microscopical work of the United States Fish Commission is pursued at the stations of the commission, very little work at present being conducted here. The Commission is located at the corner of Sixth and B streets southwest and has upon exhibition there a large number of aquaria containing marine animals in great variety, and also the means for demonstrating the modes of culture in vogue in the United States. The collection is of much interest to the naturalist and embryologist.

United States Internal Revenue Bureau.

Considerable microscopic work has been conducted in the United States Internal Revenue Bureau, under the direction of Mr. Edgar Richards. The especial use of the microscope in this bureau is *as a test for oleomargarine.*

The difference between fresh, genuine, unmelted butter and oleomargarine, which is always made in whole or in part of melted fats, can be readily and clearly detected by a microscope with the aid of polarized light and with or without the use of a selenite plate to color the field of vision.

Recently, however, an instrument has been secured, at a moderate cost and suitable for use by local officers in the markets or stores in which butter and oleomargarine are sold, which readily and clearly indicates the difference between the fresh, genuine, unmelted butter and mixtures containing melted fat.

A description of the instrument may be found in the "Regula-

tions concerning oleomargarine under internal revenue laws, April 26, 1889." One hundred of these instruments are in constant active use among the inspectors, and during the fiscal year 1889–'90 over 4,500 articles in semblance or imitation of butter were detected. Owing to the fact that efficient instruments and the necessary attachments have not been procurable except at great expense and in such form as to be suitable for use only in laboratories, this office has not been able heretofore to avail itself of the use of the microscope in testing for oleomargarine, except in the hands of the microscopist of the office. But with this simple instrument and concise directions for the inspector as to its application the bureau is doing efficient work in detection and suppression of adulteration and imitation of dairy products.

Much interesting data relative to the microscopical work of this bureau will be found in the publication before mentioned.

The Government Hospital for the Insane.

This hospital is located near Anacostia, D. C., a short distance from Washington. The number of patients resident June 30, 1890, was 1,505, which is about an average yearly attendance.

The hospital has in connection with it one of the most complete and best equipped pathological and microscopical laboratories in this country, which is under the direction of Dr. I. W. Blackburn, special pathologist. It is a model in its arrangement and is complete in every detail for the thorough conduction of pathological and microscopical investigation. It is located in a building especially adapted for its uses and commodiously arranged; is furnished with the best and most recent forms of apparatus for microscopical work; has a large and well-appointed operating-room and a good photographic department.

A valuable collection of permanent preparations, numbering some 12,000 slides, illustrative of general and cerebral pathology, forms an interesting part of this department.

Special investigations during the past few years have been made in cases of chronic epileptic dementia, general paralysis, and acute mania.

A special study and report has been made by the director of this pathological laboratory on a large number of cases of general paralysis of the insane, and the results of these examinations, embracing the clinical history, autopsy, and microscopical examination of the brain, are given in the pathological supplement to the thirty-second

annual report of the hospital. *Post mortem* examinations and critical microscopical observations have been conducted in 120 to 140 cases yearly at the hospital.

Interesting microscopical appearances, such as tortuosity of vessels, perivascular hemorrhages, and pigmentary and granular degeneration of the cells peculiar to nervous diseases of a class common to institutions for the insane, are noticeable in the reports of the pathologist.

The pathological supplement to the reports of the hospital for 1889–1890 are full of information for the student of morbid anatomy and show the thoroughness of the microscopical observations conducted in this department of the Government. The concise clinical history of the case, in conjunction with detailed *post mortem* results and microscopical examination of the cerebral tissues (of all other organs for reflex causes), has been the basis of these reports and has given profound scientific value to the labors of the pathologist.

Dr. Blackburn is making an extensive collection of cranial conformations, a collection of much interest to the anatomist and anthropologist. His photographic collection comprises also a rich and extensive series of photographs, representing every type of insane physiognomy.

Dr. Blackburn is the originator of a very simple but useful knife-carrier, a device well adapted to the requirements of the microtomist.